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International application number: PCT/BE05/000013

International filing date: 02 February 2005 (02.02.2005)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0402255.4
Filing date: 03 February 2004 (03.02.2004)

Date of receipt at the International Bureau: 07 March 2005 (07.03.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

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2. Patent application number *(The Patent Office will fill in this part)* — 0402255.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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   Antwerp

   Patents ADP number *(if you know it)* — 6354443001

   If the applicant is a corporate body, give the country/state of its incorporation — Belgium

4. Title of the invention — Roller Bearings

5. Name of your agent *(if you have one)*

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   ~~Mr J R Badger~~
   ~~Invensys Intellectual Property~~
   ~~P.O Box 8433~~
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   ~~United Kingdom~~

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   B72 1EP

   Patents ADP number *(if you know it)* — 764477100

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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   a) any applicant named in part 3 is not an inventor, or
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11. I/We request the grant of a patent on the basis of this application.

Signature P.L. Coory Date 3/2/04

12. Name and daytime telephone number of person to contact in the United Kingdom J R Badger 01527 838264

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ROLLER BEARINGS

This invention relates to roller bearings and in particular, though not exclusively, to a roller bearing for use in applications, such as in the gear units of wind turbines, in which skidding or sliding occurs between the roller and raceway (bearing) surfaces.

When the rotational speed of rollers in a roller bearing is insufficient to ensure pure rolling in the raceways, skidding could occur between the roller-and raceway surfaces. Rollers typically decelerate in the unloaded zone of the bearing and are accelerated by the raceways in the loaded zone. The force needed to accelerate the rollers is, among others, dependant on the speed difference between the roller and raceway surfaces and the roller inertia. Prolonged skidding can cause material smearing and bearing failure.

When bearings run under low-or no-load conditions, the loaded zone becomes very small or does not exist, meaning that relative sliding between the roller and-raceway surfaces is likely to occur. Should load suddenly be applied to the bearing where the relative surface speeds of the rollers and raceways is high, smearing of material could occur as the rollers are accelerated.

In wind turbines, these conditions can often be found on the high speed and intermediate shafts of speed multiplication Gear Units. Turbulence in the wind can cause drastic load changes on the gear unit and cause rollers to decelerate during low-load and accelerate again when the load increases. During coast down of the wind turbine, the torque direction on the shafts can often reverse, leading to a shift in the loaded zone position and roller skidding.

In accordance with one aspect of the present invention there is provided a roller bearing comprising a plurality of bearing rollers located radially between inner and outer bearing surfaces, said bearing surfaces being rotatable one relative to the other about the rotational axis of the bearing, and said bearing comprising biasing means which provides a force in a radial direction relative to the axis of rotation of the bearing to ensure that under all load conditions for which the bearing is designed for use each

bearing roller is retained in contact with each of said inner and outer bearing surfaces.

The bearing surfaces may be provided by inner and outer bearing rings in conventional manner, or one or each of said bearing surfaces may be defined by the surface of another component in an integrated type construction in which said other component performs an additional function.

The radial biasing effect may be provided by the or each bearing roller per se, or may be provided by additional element, for example a deformable element secured relative to one of the bearing surfaces. Additionally or alternatively it is envisaged that a biasing force may be provided by a bearing surface, for example by virtue of a part of a bearing surface being of a non-cylindrical shape when in an unstressed condition, and deformable slightly towards a cylindrical shape when acted upon by a bearing roller located between the confronting bearing surfaces.

The invention is of particular applicability to a roller bearing in which the bearing rollers are of the cylindrical type, but may be employed also for bearings comprising taper type bearing rollers.

Embodiments of the present invention are now described, by way of example only, with reference to the accompanying drawings.

The teaching of the invention is one embodiment is to introduce an elastic element(s) between the raceways and the rollers that ensures contact between these elements at all times. In Figure 1, various methods of achieving this are shown. Figure 1 (a) depicts a section of a cylindrical roller bearing with outer ring [1], roller [2] and inner ring [3]. The inner ring raceway is machined in such a way as to have a zone(s) that protrude above the normal working surface of the raceway. In this zone(s) the radial stiffness of the inner ring is reduced by, for instance, the removal of a ring of material as shown in Figure 1. When the bearing is assembled, the protruding lip(s) will be deformed and cause the rollers to be pushed against the outer raceway. The amount that the lip should protrude above the normal raceway surface will be a function of, among others, the amount of radial clearance in the bearing, the operating speed and the roller inertia.

Figure 1 (b) shows a variation on the same theme. Here the radial spring(s) takes the form of a compress-able element [4] that is inserted in the outer ring of the bearing. It could be placed in the corners of the outer ring (as shown in Figure 1 (b)) or in the middle of the ring , as in Figure 1 (c). The ring could be manufactured using an engineering elastomer.

In Figure 1 (d) the rollers are modified to create a zone(s) acting as a spring and ensuring contact between roller and raceways. Here, again, the principle is the same. The surface of the roller is machined in such a way as to cause the roller surface to protrude slightly above the normal roller surface in the low stiffness zone(s).

All of the executions shown will cause a reduction in load bearing capacity because of the fact that the load carried by the low stiffness zones will be insignificant. Such bearings could thus be more expensive when compared to standard bearings, but will have the advantage of resisting slip phenomena, which is in many cases, the root cause of ultimate bearing failure.

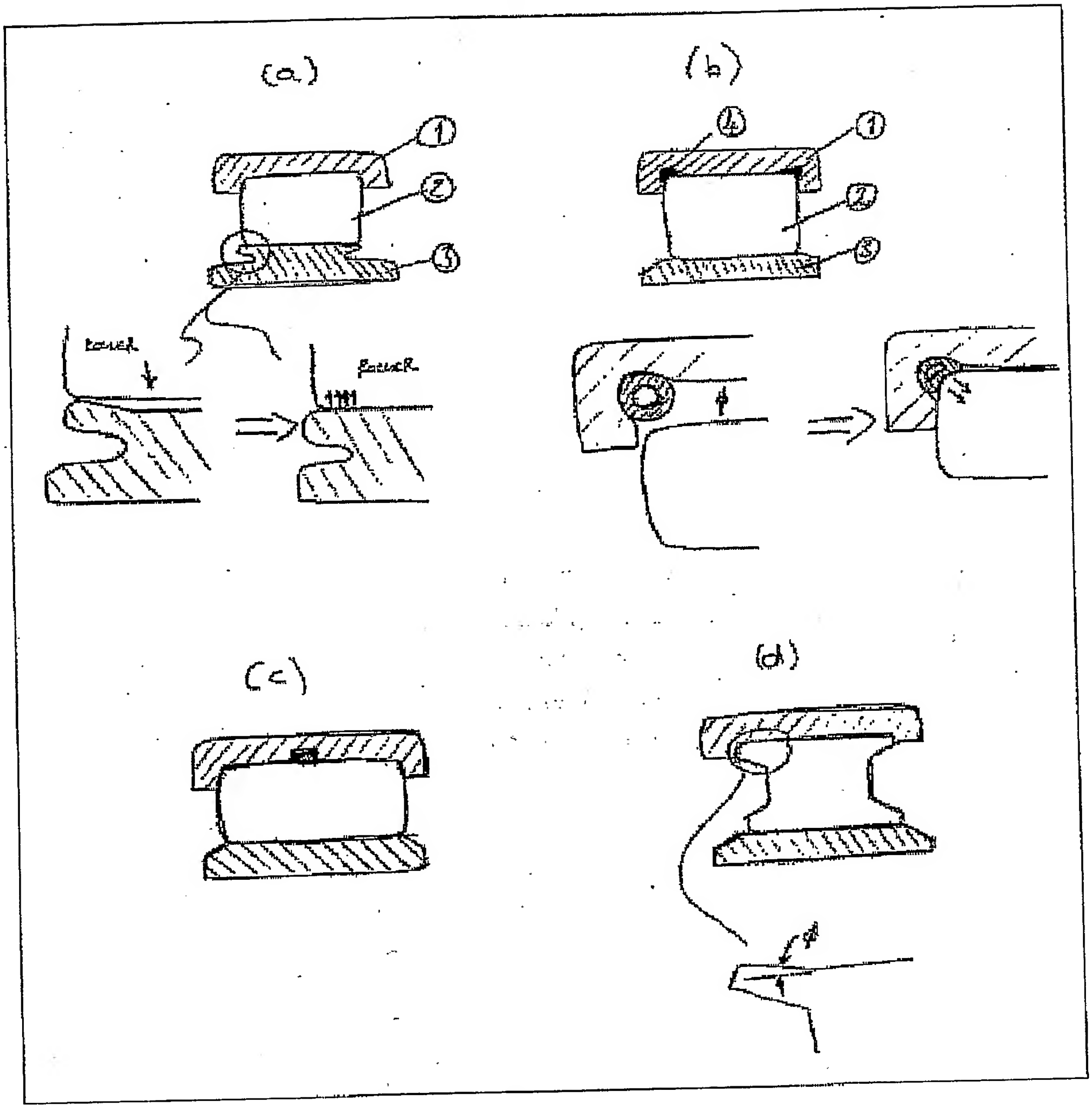

FIGURE 1